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SOME NOTES ON KANSAS GEOLOGY.

By L. C. Wooster, State Normal School, Emporia.

Read before the Academy, at Manhattan, November 27, 1903.

IN the beginnings of every science, the chief work done by the workers in the several departments consists in collecting and accumulating facts of observation and representative forms of the minerals, plants or animals in which the collector has become interested. The embryo scientist, or, more properly, naturalist, soon becomes possessed with a fever or craze for collecting. As his collection grows, his fever or craze increases in intensity or virulence till it possesses the whole man or woman. The several members of this Academy illustrate to a greater or less degree the truthfulness of this generalization.

As the collection grows, as the number of objects and observations become so great as to be burdensome, the collector is forced to arrange his collection after some plan, original or borrowed. The classification, at first rude, soon becomes more systematic, and a new craze possesses him. He loves to classify every thing within his reach, and exhausts his Greek vocabulary in securing a supply of names for his species, genera, orders, and classes. The naturalist next adds method to his madness and collects more systematically, hunting most zealously for missing links in his collection. He readily pays twenty-five or fifty dollars, as did Doctor Horn, of Berlin, for a single beetle, or he travels a thousand miles to identify a single bird.

The scientist, as he should next be called, becomes increasingly mathematical as he becomes more methodical, and time and form or space values receive his earnest attention. In geology he constructs beautiful chronologies, and tries to make his time and rock groupings conform to the mathematical terms in use in common speech. The scientist-geologist talks very confidently of the millions of years covered by his eons and eras, and, as his vision becomes more microscopic and less telescopic, with more exact data at hand, he speaks with equal assurance of the years covered by his periods, epochs, and hemeras. Unfortunately, as one scientist becomes more exact in his estimates and names his subdivisions of geological time to suit his individual plan, other scientists insist on being exact in their way, and use those names for the subdivisions of time which suit their own convenience, and a variety of chronologies results. Here, as in other fields, the fittest should survive, regardless of priority. The priority fad is certainly being overworked at the present time.

I present in the table which follows, as an introduction to my paper, the chronologies of Dana and Scott. Dana's chronology has been used for many years by the great majority of American geologists; Scott's chronology is, in its essential features, the scheme proposed by a congress of European and a few American geologists. Like most unnecessary compromises, this has failed to bring harmony, and is not accepted to this day by many eminent American geologists. I shall follow Dana's chronology in my paper, for I believe it suits the conditions here in America better than any other; and the few who need to do so can run parallels between it and any other chronology with which they wish to make an adjustment.

In the following table, I have given in the first column the formations found in central Kansas; in the second column will be found Dana's time and rock groupings; in the third column is Williams's classification, based on the dominant life forms, modified to suit Kansas conditions; and in the fourth column I have given the time and rock divisions given in Scott's Geology:

FORMATIONS.	Dana's.		Williams's.		Scott's.	
	Time.	Rocks.	In part, life.	Time.	Time.	Rocks.
Paleozoic	Eon.	Series.	Trilobiteon.	Eon.	Era.	Group.
Carbonic	Era.	System.	Phillipsian.	Era.	Period.	System.
Coal Measures	Period.	Group.	Cameratus.	Period.	Epoch.	Series.
Upper Coal Measures	Epoch.	Stage.	Myalina.	Epoch.	Age.	Stage.
Emporia limestones	Hemera.	Substage.	Coral knot.	Hemera.	... ...	Substage.

While the geological formations of Kansas are flexed less than most of the neighboring states, these formations are sufficiently tilted to make their study interesting. The slow rise of the Ozarks, due in part to denudation, has given the strata of eastern Kansas a westerly dip; and the rise of the Rocky Mountains in the Tertiary era has given the strata of western Kansas their eastward dip. In addition to these tiltings of the strata of the state from their original horizontal position, due to the rise of mountain ranges, there have been other movements nearly as potent. The first of these is the great downward flexure of the strata of Indian Territory during the Lower Coal Measure epoch. This flexure amounts, if reported correctly, to 9000 or 12,000 feet. The second disturbance of the strata of Kansas has been due to the rising, sinking and partial recovery of the northern portion of North America during the Glacial, Champlain and recent periods.

Unfortunately for the geologist, these crustal movements have not been sufficiently great to induce great and rapid changes in the life of the Kansas seas, and he is accordingly plagued, if he is a systematic geologist, or blessed, if he is an evolutionist, with transitional strata and mixed faunas and floras. It would seem in one instance, however, that these crustal movements may be used in eastern Kansas to separate the rock stages of two epochs, those of the Lower and Upper Coal Measures.

Using the thicknesses of the formations given in the University Geological Survey reports and in Adams's recent bulletin on the Upper Carboniferous rocks of Kansas, we shall find that most of the shales below the Iola limestone thicken as we proceed southward, and that the shales above the Iola limestone thicken as we go northward.

I quote the following statements from the authorities just mentioned:

"Cherokee shales—thickness of the equivalent is twenty times greater in the Indian Territory."

(The thickness of the Cherokee shales substage in Kansas is 450 feet; in Indian Territory the thickness of the equivalent deposits, those between the Mississipian limestone below and the Fort Scott limestone above, is 9000 feet.)

"Labette shales thicken southward."

"Parsons limestone thickens southward, where it includes a shale-bed."

"Galesburg shales thicken southward."

"Cherryvale shales thicken southward."

"Chanute shales thicken southward, where the substage includes more and more sandstone."

The limestones lying between these shales thin out as they are traced into the Indian Territory and these substages contain more shale and even sandstone. These peculiarities of deposition might be caused by a shore-line on the borders of the Ozark and Wichita mountains being the source of the clay and sand, and by deep, muddy seas occupying northern Indian Territory and making incursions northward into Kansas. The limestones may have been deposited in the clearer seas beyond, and in the clear water at intervals between the incursions.

With the deposition of the Iola limestone the conditions were markedly changed. After that time the shales were thicker in northern Kansas and sandstones more largely predominated in the southern part of the state. I quote again from the authorities previously mentioned:

"Lane shales thicken northward."

"Garnett limestone thickens north and west."

"Lawrence shales thicken northward and are replaced by the Chautauqua sandstone in the southern part of the state."

"Kanwaka shales become more arenaceous in southern Kansas."

"Tecumseh shales become more arenaceous southward."

"Calhoun shales thin southward."

"Burlingame shales thicken northward."

The warping of the crust of the earth, attended by the rise of the

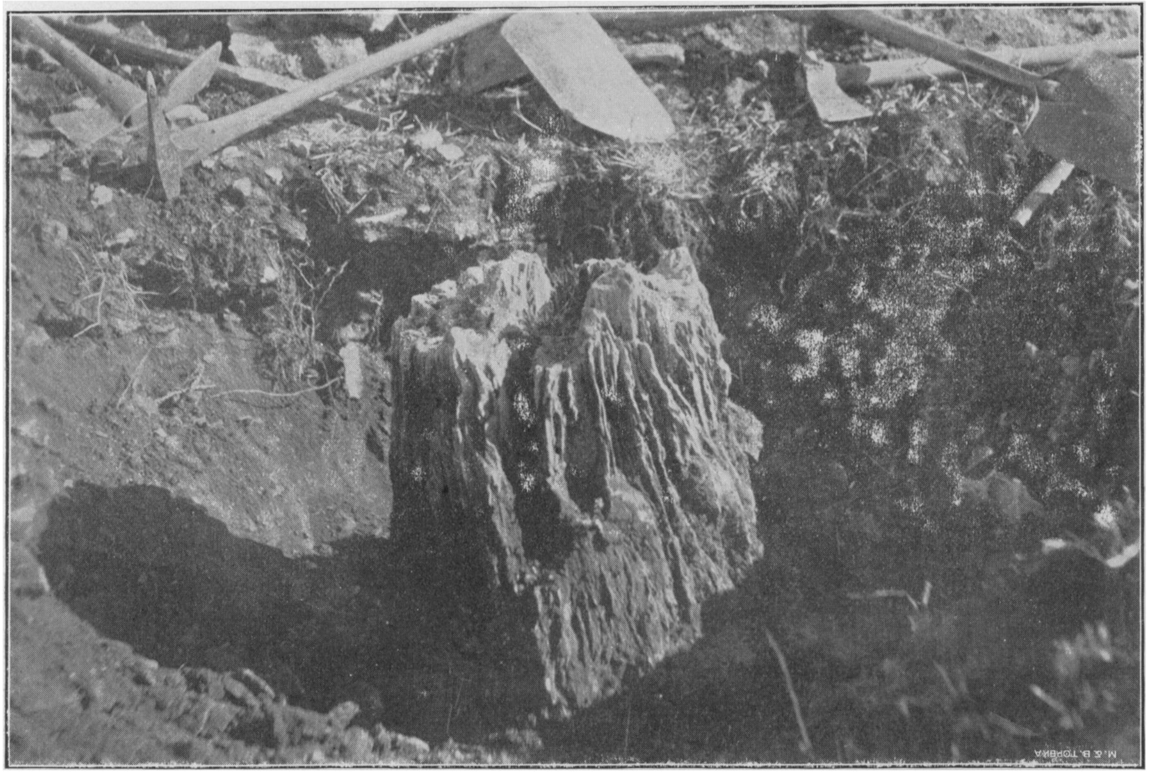

PLATE XII.—Petrified Tree Trunk in Jackson County, Exposed by Artificial Excavation.

seabottom at the south and the sinking of the seabottom at the north, which must have occurred at about the time of the deposition of the Iola limestone makes this hemera a natural break in the Coal Measure period, and gives abundant warrant for dividing the Coal Measures into the Lower and Upper epochs at the Iola limestone.

In Lyon county, the Americus limestone is not much lighter colored than the limestones below it, and is far darker than the Cottonwood limestone above. Hence the clearing of the seas of ferruginous material would, in Lyon county at least, make the time of deposition of the Cottonwood limestone a better hemera for separating the Coal Measure period from the Permian period than the Americus limestone hemera, should we make the clearing of the seas of iron the natural feature for making such division, as Adams suggests. The most marked changes in the fauna occur, too, at about the horizon of the Cottonwood limestone, and hence this hemera may well be used to mark the upper limit of the Coal Measure period.

The foldings of the crust of the earth which attended the Appalachian revolution, some crustal movements of about the same time in Indian Territory, Oklahoma, and Kansas, and possibly also some crustal movements which attended the development of the Glacial period, have thrown the strata of eastern Kansas into folds trending in Lyon county to the northeast and southwest. A careful mapping of these anticlines and synclines is work that should be done in the near future, for until this work is completed much difficulty must attend the proper correlation of the strata.

Near Neosho Rapids, in Lyon county, these movements of the crust of the earth have been accompanied by fissurings, faultings and wave-action. Fissuring attended with vertical cleavage planes may be seen in the sandstone beneath the Eureka limestone near Neosho Rapids and in a sandstone beneath the Emporia limestones at Emporia. The faulting is shown by a heavy displacement of strata about two miles northwest of Neosho Rapids, along the Neosho river. The wave-action is best seen in a railroad cut about one mile west of Neosho Rapids. At this point is a section forty feet in thickness of a rock composed of limestone fragments, but with the cross-bedding and peculiar weathering of sandstone. This sandstone-limestone thins out rapidly, and two miles to the northward is only a few inches thick. To the southwestward it holds its thickness better, so far as traced. Fossils are not common in this rock. The few that were collected were entire. The source of the material of this sandstone-limestone can only be conjectured. Possibly it was derived from a concretionary limestone which belongs at the same horizon and may be seen beneath its northern margin.